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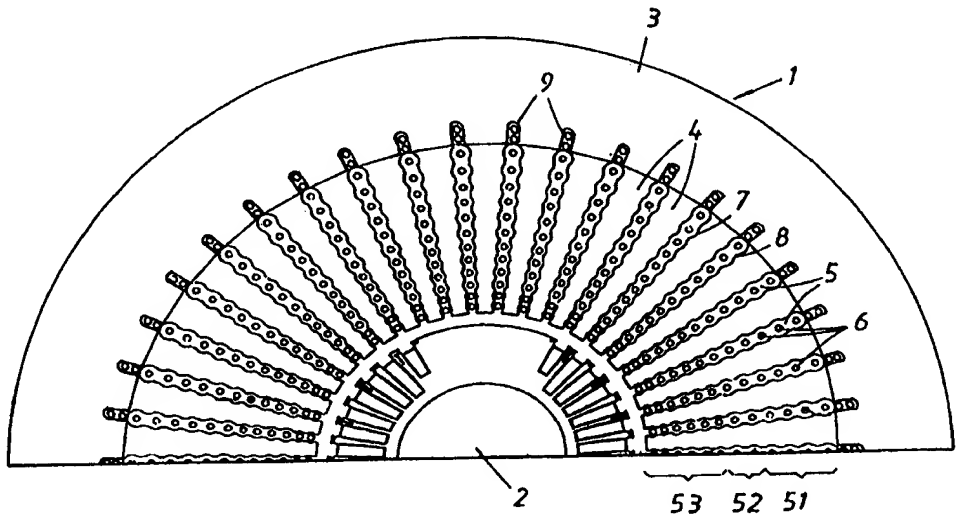

(57) Abstract

The magnetic circuit of synchronous compensator plant is included in an electric machine which is directly connected to a high supply voltage of 20-800 kV, preferably higher than 36 kV. The electric machine is provided with solid insulation and its winding(s) is/are built up of a cable (6) intended for high voltage comprising one or more current-carrying conductors (31) with a number of strands (36) surrounded by at least one outer and one inner semiconducting layer (34, 32) and intermediate insulating layers (33). The outer semiconducting layer (34) is at earth potential. The phases of the winding are Y-connected, and the Y-point may be insulated and protected from over-voltage by means of surge arresters, or else the Y-point is earthed via a suppression filter. A procedure is used in the manufacture of a synchronous compensator for such plant, in which the cable used is threaded into the openings in the core for the magnetic circuit of the synchronous compensator.

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SYNCHRONOUS COMPENSATOR PLANT

Technical field:

The present invention relates to electric machines intended for connection to distribution or transmission networks, hereinafter termed power networks. More specifically the invention relates to synchronous compensator plants for the above purpose.

Background art:

Reactive power is present in all electric power systems that transfer alternating current. Many loads consume not only active power but also reactive power. Transmission and distribution of electric power per se entails reactive losses as a result of series inductances in transformers, overhead lines and cables. Overhead lines and cables also produce reactive power as a result of capacitive connections between phases and between phases and earth potential.

At stationary operation of an alternating current system, active power production and consumption must be in agreement in order to obtain nominal frequency. An equally strong coupling exists between reactive power balance and voltages in the electric power network. If reactive power consumption and production are not balanced in a suitable manner, the consequence may be unacceptable voltage levels in parts of the electric power network. An excess of reactive power in one area leads to high voltages, whereas a deficiency leads to low voltages.

Contrary to active power balance at a nominal frequencies, which is controlled solely with the aid of the active power starter of the generator, a suitable reactive power balance is obtained with the aid of both controllable excitation of synchronous generators and of other components spread out in the system. Examples of such (phase compensation) components are shunt reactors, shunt capacitors, synchronous compensators and SVCs (Static Var. Compensators).

The location of these phase compensation components in the electric power network affects not only the voltage in various parts of the electric power network, but also the losses in the electric power network since the transfer of reactive power, like the transfer of active power, gives rise to losses and thus heating. It is consequently desirable to place phase compensation components so

that losses are minimized and the voltage in all parts of the electric power network is acceptable.

The shunt reactor and shunt capacitor are usually permanently connected or connected via a mechanical breaker mechanism to the electric power network. In other words, the reactive power consumed/produced by these components is not continuously controllable. The reactive power produced/consumed by the synchronous compensator and the SVC, on the other hand, is continuously controllable. These two components are consequently used if there is a demand for high-performance voltage control.

The following is a brief description of the technology for phase compensation with the aid of synchronous compensator and SVC.

A synchronous compensator is in principle a synchronous motor running at no load, i.e. it takes active power from the electric power network equivalent to the machine losses.

The rotor shaft of a synchronous compensator is usually horizontal and the rotor generally has six or eight salient poles. The rotor is usually dimensioned thermally so that the synchronous compensator, in over-excited state, can producr approximately 100 % of the apparent power the stator is thermally dimensioned for (rated output) in the form of reactive power. In under-excited state, when the synchronous compensator consumes reactive power, it consumes approximately 60 % of the rated output (standard value, depending on how the machine is dimensioned). This gives a control area of approximately 160 % of rated output over which the reactive power consumption/production can be continuously controlled. If the machine has salient poles with relatively little reactance in transverse direction, and is provided with excitation equipment enabling both positive and negative excitation, more reactive power can be consumed than the 60 % of rated output stated above, without the machine exceeding the stability limit. Modern synchronous compensators are normally equipped with fast excitation systems, preferably a thyristor-controlled static exciter where the direct current is supplied to the rotor via slip rings. This solution enables both positive and negative supply as above.

The magnetic circuits in a synchronous compensator usually comprise a laminated core, e.g. of sheet steel with a welded construction. To provide ventilation and cooling the core is often divided into stacks with radial and/or axial ventilation ducts. For larger machines the laminations are punched out in segments which are attached to the frame of the machine, the laminated core being held

together by pressure fingers and pressure rings. The winding of the magnetic circuit is disposed in slots in the core, the slots generally having a cross section in the shape of a rectangle or trapezium.

In multi-phase electric machines the windings are made as either single or double layer windings. With single layer windings there is only one coil side per slot, whereas with double layer windings there are two coil sides per slot. By coil side is meant one or more conductors combined vertically or horizontally and provided with a common coil insulation, i.e. an insulation designed to withstand the rated voltage of the machine to earth.

Double-layer windings are generally made as diamond windings whereas single layer windings in the present context can be made as diamond or flat windings. Only one (possibly two) coil width exists in diamond windings whereas flat windings are made as concentric windings, i.e. with widely varying coil width. By coil width is meant the distance in arc dimension between two coil sides pertaining to the same coil.

Normally all large machines are made with double-layer winding and coils of the same size. Each coil is placed with one side in one layer and the other side in the other layer. This means that all coils cross each other in the coil end. If there are more than two layers these crossings complicate the winding work and the coil end is less satisfactory.

It is considered that coils for rotating machines can be manufactured with good results up to a voltage range of 10 - 20 kV.

A synchronous compensator has considerable short-duration overload capacity. In situations when electro-mechanical oscillations occur in the power system the synchronous compensator can briefly supply reactive power up to twice the rated output. The synchronous compensator also has a more long-lasting overload capacity and is often able to supply 10 to 20 % more than rated output for up to 30 minutes.

Synchronous compensators exist in sizes from a few MVA to hundreds of MVA. The losses for a synchronous compensator cooled by hydrogen gas amount to approximately 10 W/kvar, whereas the corresponding figure for air-cooled synchronous compensators is approximately 20 W/kvar.

Synchronous compensators were preferably installed in the receiving end of long radial transmission lines and in important nodes in masked electric power networks with long transmission lines,

particularly in areas with little local generation. The synchronous compensator is also used to increase the short-circuit power in the vicinity of HVDC inverter stations.

The synchronous compensator is most often connected to points in the electric power network where the voltage is substantially higher than the synchronous compensator is designed for. This means that, besides the synchronous compensator, the synchronous compensator plant generally includes a step-up transformer, a busbar system between synchronous compensator and transformer, a generator breaker between synchronous compensator and transformer, and a line breaker between transformer and electric power network, see the single-line diagram in Figure 1.

In recent years SVCs have to a great extent replaced synchronous compensators in new installations because of their advantages particularly with regard to cost, but also in certain applications because of technical advantages.

The SVC concept (Static Var. Compensator) is today the leading concept for reactive power compensation and, as well as in many cases replacing the synchronous compensator in the transmission network, it also has industrial applications in connection with electric arc furnaces. SVCs are static in the sense that, contrary to synchronous compensators, they have no movable or rotating main components.

SVC technology is based on rapid breakers built up of semi-conductors, thyristors. A thyristor can switch from isolator to conductor in a few millionths of a second. Capacitors and reactors can be connected or disconnected with negligible delay with the aid of thyristor bridges. By combining these two components reactive power can be steplessly either supplied or extracted. Capacitor banks with different reactive power enable the supplied reactive power to be controlled in steps.

A SVC plant consists of both capacitor banks and reactors and since the thyristors generate harmonics, the plant also includes harmonic filters. Besides control equipment, a transformer is also required between the compensation equipmentand the network in order to obtain optimal compensation from the size and cost point of view. SVC plant is available in size from a few MVA up to 650 MVA, with nominal voltages up to 765 kV.

Various SVC plant types exist, named after how the capacitors and reactors are combined. Two usual elements that may be included are TSC or TCR. TSC is a thyristor-controlled reactive power-producing

capacitor and TCR is a thyristor-controlled reactive power-consuming reactor. A usual type is a combination of these elements, TSC/TCR.

The magnitude of the losses depends much on which type of plant the SVC belongs to, e.g. a FC/TCR type (FC means that the capacitor is fixed) has considerably greater losses than a TSC/TCR. The losses for the latter type are approximately comparable with the losses for a synchronous compensator.

It should be evident from the above summary of the phase compensation technology that this can be divided into two principal concepts, namely synchronous compensation and SVC.

These concepts have different strengths and weaknesses. Compared with the synchronous compensator, the SVC has the main advantage of being cheaper. However, it also permits somewhat faster control which may be an advantage in certain applications.

The drawbacks of the SVC as compared with the synchronous compensator include:

- it has no overload capacity. In operation at its capacitive limit the SVC becomes in principle a capacitor, i.e. if the voltage drops then the reactive power production drops with the square of the voltage. If the purpose of the phase compensation is to enable transfer of power over long distances the lack of overload capacity means that, in order to avoid stability problems, a higher rated output must be chosen if SVC plant is selected than if synchronous compensator plant is selected.
- it requires filters if it includes a TCR.
- it does not have a rotating mass with internal voltage source. This is an advantage with the synchronous compensator, particularly in the vicinity of HVDC transmission.

The present invention relates to a new synchronous compensator plant.

Rotating electric machines have started to be used, for instance, for producing/consuming reactive power with the object of achieving phase compensation in a network.

The following is a brief description of this technology, i.e. phase compensation by means of synchronous compensators and other conventional technology for compensating reactive power.

Reactive power should be compensated locally at the consumption point in order to avoid reactive power being transferred to the

network and giving rise to losses. The shunt reactor, shunt capacitors, synchronous compensator and SVC represent different ways of compensating for the need for reactive power in transmission and sub-transmission networks.

A synchronous compensator is in principle a synchronous motor running in neutral, i.e. it takes active power from the network, corresponding to the losses of the machine. The machine can be under-excited or over-excited in order to consume or produce reactive power, respectively. Its production/consumption of reactive power can be continuously regulated.

In over-excited state the synchronous compensator has a relatively large short-term overload capacity of 10-20% for up to 30 minutes. In under-excited state, when the machine consumes reactive power, it can normally consume approximately 60% of rated output (standard value depending on how the machine is dimensioned). This gives a control area of approximately 160 % of rated output.

If the machine has salient poles with relatively little reactance in transverse direction and is provided with excitation plant enabling negative excitation, it is possible for more reactive power to be consumed than the above-stated 60 % of rated output, without the machine exceeding the stability limit. Modern synchronous compensators are normally equipped with rapid excitation systems, preferably a thyristor-controlled static exciter in which the direct current is supplied to the rotor via slip rings. This solution also permits negative excitation in accordance with the above.

Synchronous compensators are used today primarily to generate and consume reactive power in the transmission network in connection with HVDC inverter stations because of the ability of the synchronous compensator to increase the short-circuiting capacity, which the SVC lacks. In recent years the SVC has replaced the synchronous compensator in new installations because of its advantages as regards cost and construction.

The present invention relates to the first-mentioned concept, i.e. synchronous compensation.

Description of the invention:

Against this background, one object of the invention is to provide a better synchronous compensator plant than is possible with known technology, by reducing the number of electrical components

necessary when it is to be connected to high-voltage networks, including those at a voltage level of 36 kV and above.

This object has been achieved according to a first aspect of the invention in that a plant of the type described in the preamble to claim 1 comprises the special features defined in the characterizing part of the claim.

Thanks to the fact that the winding(s) in the rotating electric machine in the synchronous compensator plant is/are manufactured with this special solid insulation, a voltage level can be achieved for the machine which is far above the limits a conventional machine of this type can be practically or financially constructed for. The voltage level may reach any level applicable in power networks for distribution and transmission. The advantage is thus achieved that the synchronous compensator can be connected directly to such networks without intermediate connection of a step-up transformer.

Elimination of the transformer per se entails great savings in cost, weight and space, but also has other decisive advantages over a convention synchronous compensator plant.

The efficiency of the plant is increased and the losses are avoided that are incurred by the transformer's consumption of reactive power and the resultant turning of the phase angle. This has a positive effect as regards the static and dynamic stability margins of the system. Furthermore, a convention transformer contains oil, which entails a fire risk. This is eliminated in a plant according to the invention, and the requirement for various types of fire-precautions is reduced. Many other electrical coupling components and protective equipment are also reduced. This gives reduced plant costs and less need for service and maintenance.

These and other advantages result in a synchronous compensator plant being considerably smaller and less expensive than a conventional plant, and that the operating economy is radically improved thanks to less maintenance and smaller losses.

Thanks to these advantages a synchronous compensator plant according to the invention will contribute to this concept being financially competitive with the SVC concept (see above) and even offering cost benefits in comparison with this.

The fact that the invention makes the synchronous compensator concept competitive in comparison with the SVC concept therefore enables a return to the use of synchronous compensator plants. The drawbacks associated with SVC compensation are thus no longer

relevant. The complicated, bulky banks of capacitors and reactors in a SVC plant are one such drawback. Another big drawback with SVC technology is its static compensation which does not give the same stability as that obtained by the inertia obtained in a rotating electric machine with its rotating e.m.f. as regards both voltage and phase angle. A synchronous compensator is therefore better able to adjust to temporary interference in the network and to fluctuations in the phase angle. The thyristors that control a SVC plant are also sensitive to displacement of the phase angle. A plant according to the invention also enables the problem of harmonics to be solved.

The synchronous compensator plant according to the invention thus enables the advantages of synchronous compensator technology over SVC technology to be exploited so that a more efficient and stable compensation is obtained at a cost superior to this from the point of view of both plant investment and operation.

The plant according to the invention is small, inexpensive, efficient and reliable, both in comparison with a conventional synchronous compensator and a SVC.

Another object of the invention is to satisfy the need for fast, continuously controllable reactive power which is directly connected to sub-transmission or transmission level in order to manage the system stability and/or dependence on rotating mass and the electro-motive force in the vicinity of HVDC transmission. The plants shall be able to supply anything from a few MVA up to thousands of MVA.

The advantage gained by satisfying said objects is the avoidance of the intermediate transformer, the reactance of which otherwise consumes reactive power. This also enables the avoidance of traditional high-power breakers. Advantages are also obtained as regards network quality since there is rotating compensation. With a plant according to the invention the overload capacity is also increased, which with the invention may be +100 %. The synchronous compensator according to the invention may be given higher overload capacity in over-excited operation than conventional synchronous compensators, both as regards short-during and long-duration overload capacity. This is primarily because the time constants for heating the stator are large with electric insulation of the stator winding according to the invention. However, the thermal dimensioning of the rotor must be such that it does not limit the possibilities of exploiting this overload capacity. This enables

the use of a smaller machine. The control region may be longer than with existing technology.

To accomplish this the magnetic circuit in the electric machine included in the synchronous compensator plant is formed with threaded permanent insulating cable with included earth. The invention also relates to a procedure for manufacturing such a magnetic circuit.

The major and essential difference between known technology and the embodiment according to the invention is thus that this is achieved with an electric machine provided with solid insulation, the magnetic circuit(s) of the winding(s) being arranged to be directly connected via breakers and isolators to a high supply voltage of between 20 and 800 kV, preferably higher than 36 kV. The magnetic circuit thus comprises a laminated core having a winding consisting of a threaded cable with one or more permanently insulated conductors having a semiconducting layer both at the conductor and outside the insulation, the outer semiconducting layer being connected to earth potential.

To solve the problems arising with direct connection of electric machines to all types of high-voltage power networks, a machine in the plant according to the invention has a number of features as mentioned above, which differ distinctly from known technology. Additional features and further embodiments are defined in the dependent claims and are discussed in the following.

Such features mentioned above and other essential characteristics of the synchronous compensator plant and the electric machine according to the invention included therein, include the following:

- The winding of the magnetic circuit is produced from a cable having one or more permanently insulated conductors with a semiconducting layer at both conductor and sheath. Some typical conductors of this type are PEX cable or a cable with EP rubber insulation which, however, for the present purpose are further developed both as regards the strands in the conductor and the nature of the outer sheath. PEX = crosslinked polyethylene (XLPE). EP = ethylene propylene.

- Cables with circular cross section are preferred, but cables with some other cross section may be used in order to obtain better packing density, for instance.

- Such a cable allows the laminated core to be designed according to the invention in a new and optimal way as regards slots and teeth.

- The winding is preferably manufactured with insulation in steps for best utilization of the laminated core.

- The winding is preferably manufactured as a multi-layered, concentric cable winding, thus enabling the number of coil-end intersections to be reduced.

- The slot design is suited to the cross section of the winding cable so that the slots are in the form of a number of cylindrical openings running axially and/or radially outside each other and having an open waist running between the layers of the stator winding.

- The design of the slots is adjusted to the relevant cable cross section and to the stepped insulation of the winding. The stepped insulation allows the magnetic core to have substantially constant tooth width, irrespective of the radial extension.

- The above-mentioned further development as regards the strands entails the winding conductors consisting of a number of impacted strata/layers, i.e. insulated strands that from the point of view of an electric machine, are not necessarily correctly transposed, uninsulated and/or insulated from each other.

- The above-mentioned further development as regards the outer sheath entails that at suitable points along the length of the conductor, the outer sheath is cut off, each cut partial length being connected directly to earth potential.

The use of a cable of the type described above allows the entire length of the outer sheath of the winding, as well as other parts of the plant, to be kept at earth potential. An important advantage is that the electric field is close to zero within the coil-end region outside the outer semiconducting layer. With earth potential on the outer sheath the electric field need not be controlled. This means that no field concentrations will occur either in the core, in the coil-end regions or in the transition between them.

The mixture of insulated and/or uninsulated impacted strands, or transposed strands, results in low stray losses.

The cable for high voltage used in the magnetic circuit winding is constructed of an inner core/conductor with a plurality of strands, at least two semiconducting layers, the innermost being surrounded by an insulating layer, which is in turn surrounded by an outer semiconducting layer having an outer diameter in the order of 20-250 mm and a conductor area in the order of 30-3000 mm^2.

According to a particularly preferred embodiment of the invention, at least two of these layers, preferably all three, have the same coefficient of thermal expansion. The decisive benefit is thus achieved that defects, cracks or the like are avoided at thermal movement in the winding.

The invention also relates to a procedure for manufacturing the magnetic circuit for the electric machine included in the synchronous compensator plant. The procedure entails the winding being placed in the slots by threading the cable through the cylindrical openings in the slots.

From another aspect of the invention, the object has been achieved in that a plant of the type described in the preamble to claim 35 is given the special features defined in the characterizing part of this claim.

Since the insulation system, suitably permanent, is designed so that from the thermal and electrical point of view it is dimensioned for over 36 kV, the plant can be connected to high-voltage power networks without any intermediate step-up transformer, thereby achieving the advantages referred to above. Such a plant is preferably, but not necessarily, constructed to include the features defined for the plant as claimed in any of claims 1-34.

The above-mentioned and other advantageous embodiments of the invention are defined in the dependent claims.

Brief description of the drawings:

The invention will be described in more detail in the following detailed description of a preferred embodiment of the construction of the magnetic circuit of the electrical machine in the synchronous compensator plant, with reference to the accompanying drawings in which

Figure 1 shows a single line diagram of the invented synchronous compensator plant.

Figure 2 shows a schematic axial end view of a sector of the stator in an electric machine in the synchronous compensator plant according to the invention, and

Figure 3 shows an end view, step-stripped, of a cable used in the winding of the stator according to Figure 2

Description of a preferred embodiment:

Figure 1 shows a single line diagram of the synchronous compensator plant according to a preferred embodiment of the invention, where the machine is arranged for direct connection to the power network, without any step-up transformer, at two different voltage levels.

In the schematic axial view through a sector of the stator 1 according to Figure 2, pertaining to the electric machine included in the synchronous compensator plant, the rotor 2 of the machine is also indicated. The stator 1 is composed in conventional manner of a laminated core. Figure 1 shows a sector of the machine corresponding to one pole pitch. From a yoke part 3 of the core situated radially outermost, a number of teeth 4 extend radially in towards the rotor 2 and are separated by slots 5 in which the stator winding is arranged. Cables 6 forming this stator winding, are high-voltage cables which may be of substantially the same type as those used for power distribution, i.e. PEX cables. One difference is that the outer, mechanically-protective sheath, and the metal screen normally surrounding such power distribution cables are eliminated so that the cable for the present application comprises only the conductor and at least one semiconducting layer on each side of an insulating layer. Thus, the semiconducting layer which is sensitive to mechanical damage lies naked on the surface of the cable.

The cables 6 are illustrated schematically in Figure 2, only the conducting central part of each cable part or coil side being drawn in. As can be seen, each slot 5 has varying cross section with alternating wide parts 7 and narrow parts 8. The wide parts 7 are substantially circular and surround the cabling, the waist parts between these forming narrow parts 8. The waist parts serve to radially fix the position of each cable. The cross section of the slot 5 also narrows radially inwards. This is because the voltage on the cable parts is lower the closer to the radially inner part of the stator 1 they are situated. Slimmer cabling can therefore be used there, whereas coarser cabling is necessary further out. In the example illustrated, cables of three different dimensions are used, arranged in three correspondingly dimensioned sections 51, 52, 53 of slots 5. An auxiliary power winding 9 is arranged outermost.

Figure 3 shows a step-wise stripped end view of a high-voltage cable for use in an electric machine according to the present invention. The high-voltage cable 6 comprises one or more conductors 31, each of which comprises a number of strands 36 which

together give a circular cross section of copper (Cu), for instance. These conductors 31 are arranged in the middle of the high-voltage cable 6 and in the shown embodiment each is surrounded by a part insulation 35. However, it is feasible for the part insulation 35 to be omitted on one of the four conductors 31. The number of conductors 31 need not, of course, be restricted to four, but may be more or less. The conductors 31 are together surrounded by a first semiconducting layer 32. Around this first semiconducting layer 32 is an insulating layer 33, e.g. PEX insulation, which is in turn surrounded by a second semiconducting layer 34. Thus the concept "high-voltage cable" in this application need not include any metallic screen or outer sheath of the type that normally surrounds such a cable for power distribution.

CLAIMS

1. A synchronous compensator plant comprising at least one rotating electric machine having at least one winding, characterized in that the winding in at least one of the electric machines comprises an insulation system including at least two semiconducting layers, each layer constituting essentially an equipotential surface and also including solid insulation disposed therebetween.

2. A plant as claimed in claim 1, characterized in that at least one of the layers has substantially the same coefficient of thermal expansion as the solid insulation.

3. A plant as claimed in either of claims 1 or 2, characterized in that the insulation is built up of a cable (6) intended for high voltage and comprising one or more current-carrying conductors (31) surrounded by at least one semiconducting layer (32, 34) with intermediate insulating layer (33) of solid insulation.

4. A plant as claimed in claim 3, characterized in that the innermost semiconducting layer (32) is at substantially the same potential as the conductor(s) (31).

5. A plant as claimed in either of claims 3 or 5, characterized in that the one of the outer semiconducting layers (34) is arranged to form essentially an equipotential surface surrounding the conductor(s) (31).

6. A plant as claimed in claim 5, characterized in that said outer semiconducting layer (34) is connected to a selected potential.

7. A plant as claimed in claim 6, characterized in that the selected potential is earth potential.

8. A plant as claimed in any of claims 3-7, characterized in that at least two of said layers have substantially the same coefficient of thermal expansion.

9. A plant as claimed in any of claims 3-5, characterized in that the current carrying conducting comprises a plurality of strands, only a few of the strands being uninsulated from each other.

10. A plant as claimed in any of claims 1-9, characterized in that the winding consists of a cable

comprising one or more current-carrying conductors (2), each conductor consisting of a number of strands, an inner semiconducting layer (3) being arranged around each conductor, an insulating layer (4) of solid insulation being arranged around each inner semiconducting layer (3) and an outer semiconducting layer (5) being arranged around each insulating layer (4).

11. A plant as claimed in claim 10, characterized in that the cable also comprises a metal screen and a sheath.

12. A plant as claimed in any of the preceding claims, characterized in that the magnetic circuit is arranged in a rotating electric machine, the stator (3) of which is cooled at earth potential.

13. A plant as claimed in any of the preceding claims, characterized in that the magnetic circuit of the electric machine comprises a stator winding placed in a slot (5), said slot (5) being designed as a number of cylindrical openings (7) running axially and radially outside each other, having substantially circular cross section and separated by narrow waist parts (8) between the cylindrical openings.

14. A plant as claimed in claim 13, characterized in that the phases of the stator winding are Y-connected.

15. A plant as claimed in claim 14, characterized in that the Y-point of the stator winding is insulated from earth potential or connected to earth potential via a high-ohmic impedance and protected from over-voltages by means of surge arresters.

16. A plant as claimed in claim 14, characterized in that the Y-point of the stator winding is earthed via a suppression filter of third harmonic type, which suppression filter is designed to greatly reduce or eliminate third harmonic currents in the electric machine at the same time as being dimensioned to limit voltages and currents in the event of faults in the plant.

17. A plant as claimed in claim 16, characterized in that the suppression filter is protected from over-voltages by means of surge arresters, the latter being connected in parallel with the suppression filter.

18. A plant as claimed in claims 3 and 14, characterized in that the cable (6) constituting the stator winding has a gradually decreasing insulation seen from the high-voltage side towards the Y-point.

19. A plant as claimed in claim 18, characterized in that the gradual decrease in the insulation thickness is stepwise or continuous.

20. A plant as claimed in claims 13 and 18, characterized in that the circular cross section (7) of the substantially cylindrical slots (5) for the stator winding has decreasing radius seen from the yoke portion towards the rotor.

21. A plant as claimed in any of claims 12-20, characterized in that the rotating part has an inertia and electromotive force.

22. A plant as claimed in claim 21, characterized in that the machine can be started from a local power supply.

23. A plant as claimed in claim 22, characterized in that the machine has two or more poles.

24. A plant as claimed in claim 23, characterized in that the rotor (2) and the stator (3) are so dimensioned that at nominal voltage, nominal power factor and over-excited operation, the thermally based current limits of stator and rotor are exceeded approximately simultaneously.

25. A plant as claimed in claim 23, characterized in that the rotor (2) and the stator (3) are so dimensioned that at nominal voltage, nominal power factor and over-excited operation, the thermally based stator current limit is exceeded before the thermally based rotor current limit has been exceeded.

26. A plant as claimed in either of claims 24 or 25, characterized in that is has 100% overload capacity at nominal voltage, nominal power factor and at over-excited operation.

27. A plant as claimed in claim 24 or claim 25, characterized in that the rotor poles are pronounced.

28. A plant as claimed claim 27, characterized in that the quadrature-axis synchronous reactance is considerably less than the direct-axis synchronous reactance.

29. A plant as claimed claim 28, characterized in that the machine is equipped with excitation systems enabling both positive and negative excitation.

30. A plant as claimed in any of claims 3-29, characterized in that the cables (6) with solid insulation intended

for high voltage have a conductor area between 30 and 3000 mm^2 and have an outer cable diameter of between 20 and 250 mm.

31. A plant as claimed in any of the preceding claims, characterized in that the stator and rotor circuits (3, 2) are provided with cooling means in which the coolant is in liquid and/or gaseous form.

32. A plant as claimed in any of the preceding claims, characterized in that the machine is arranged for connection to several different voltage levels.

33. A plant as claimed in any of claims 1-32, characterized in that the machine is connected to the power network without any step-up transformer.

34. A plant as claimed in any of the preceding claims, characterized in that the winding of the machine is arranged for self-regulating field control and lacks auxiliary means for control of the field.

35. A synchronous compensator plant comprising at least one rotating electric machine having at least one winding, characterized in that the winding has an insulation system which, as regards its thermal and electrical properties, permits a voltage level in the machine exceeding 36 kV.

36. A synchronous compensator plant as claimed in claim 35, characterized in that it includes the features defined for the plant as claimed in any of claims 1-34.

37. A rotating electric machine in the form of a synchronous compensator having at least one winding, characterized in that the winding comprises an insulation system including at least two semiconducting layers, each layer constituting essentially one equipotential surface, with solid insulation disposed therebetween.

38. A rotating electric machine as claimed in claim 37, characterized in that it includes the features defined for the electrical machine in the plant as claimed in any of claims 2-36.

Fig.1

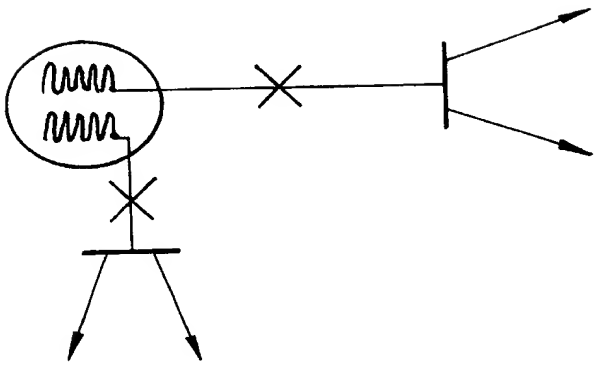


Fig. 2

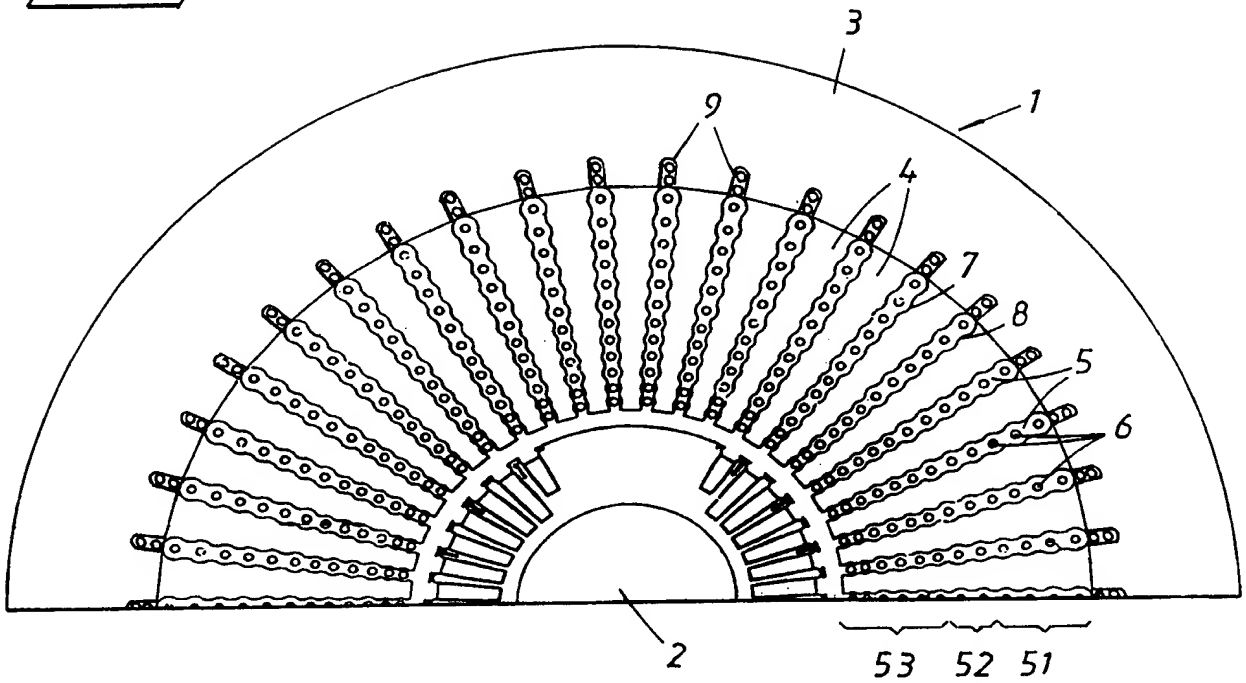
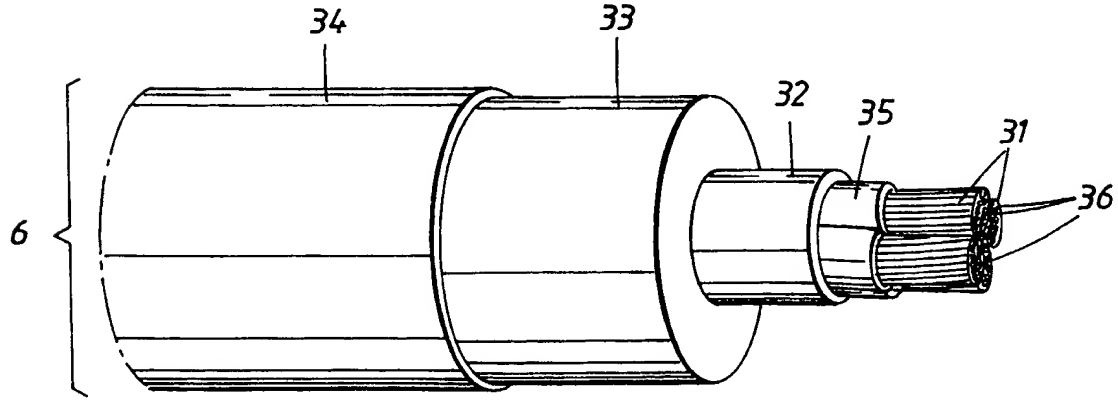


Fig. 3



INTERNATIONAL SEARCH REPORT

International application No.
PCT/SE 97/00884

A. CLASSIFICATION OF SUBJECT MATTER

IPC6: H02K 3/40
According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC6: H02K

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

SE,DK,FI,NO classes as above

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 5036165 A (RICHARD K. ELTON ET AL.), 30 July 1991 (30.07.91), abstract, see the whole document	1-34,36-38
A	US 4429244 A (NIKITIN ET AL), 31 January 1984 (31.01.84), column 1, line 10 - line 58	1-34,36-38
A	SE 453236 B (ELIN-UNION AG FÜR ELECTRISCHE INDUSTRIE), 18 January 1988 (18.01.88), abstract	1-34,36-38
A	US 4091139 A (QUIRK), 23 May 1978 (23.05.78), abstract	1-34,36-38

☐ Further documents are listed in the continuation of Box C. ☒ See patent family annex.

* Special categories of cited documents:
"A" document defining the general state of the art which is not considered to be of particular relevance
"E" erlier document but published on or after the international filing date
"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)
"O" document referring to an oral disclosure, use, exhibition or other means
"P" document published prior to the international filing date but later than the priority date claimed
"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
"X" document of particular relevance: the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
"Y" document of particular relevance: the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
8 Sept 1997	19. 09. 1997
Name and mailing address of the ISA/ Swedish Patent Office Box 5055, S-102 42 STOCKHOLM Facsimile No. +46 8 666 02 86	Authorized officer Magnus Hjalmarsson Telephone No. +46 8 782 25 00

INTERNATIONAL SEARCH REPORT

Information on patent family members

06/08/97

International application No.
PCT/SE 97/00884

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 5036165 A	30/07/91	US 5066881 A	19/11/91
		US 5067046 A	19/11/91
		CA 1245270 A	22/11/88
		US 4853565 A	01/08/89
US 4429244 A	31/01/84	CA 1167898 A	22/05/84
		CH 663120 A,B	13/11/87
		DE 3050139 T	25/03/82
		FR 2473804 A,B	17/07/81
		GB 2081523 A,B	17/02/82
		JP 56501707 T	19/11/81
		SU 961048 A	23/09/82
		WO 8101775 A	25/06/81
SE 453236 B	18/01/88	AT 378287 A	10/07/85
		CH 657482 A,B	29/08/86
		DE 3200366 A	09/12/82
		FR 2499306 A,B	06/08/82
		SE 8200303 A	31/07/82
US 4091139 A	23/05/78	BE 846361 A	17/03/77
		CA 1071480 A	12/02/80
		CH 607251 A	30/11/78
		DE 2641406 A	31/03/77
		GB 1565696 A	23/04/80
		JP 1047401 C	28/05/81
		JP 52036783 A	22/03/77
		JP 55041483 B	24/10/80

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PCT

REQUEST

The undersigned requests that the present international application be processed according to the Patent Cooperation Treaty.

For receiving Office use only

International Application No.

International Filing Date

Name of receiving Office and "PCT International Application"

Applicant's or agent's file reference *(if desired) (12 characters maximum)* P 97-086/LK /uh

Box No. I TITLE OF INVENTION

SYNCHRONOUS COMPENSATOR PLANT

Box No. II APPLICANT

Name and address: *(Family name followed by given name; for a legal entity, full official designation. The address must include postal code and name of country. The country of the address indicated in this Box is the applicant's State (i.e. country) of residence if no State of residence is indicated below.)*

Asea Brown Boveri AB

S-721 83 VÄSTERÅS
Sweden

☐ This person is also inventor.

Telephone No.

Facsimile No.

Teleprinter No.

State *(i.e. country)* of nationality: SE

State *(i.e. country)* of residence: SE

This person is applicant for the purposes of: ☐ all designated States ☒ all designated States except the United States of America ☐ the United States of America only ☐ the States indicated in the Supplemental Box

Box No. III FURTHER APPLICANT(S) AND/OR (FURTHER) INVENTOR(S)

Name and address: *(Family name followed by given name; for a legal entity, full official designation. The address must include postal code and name of country. The country of the address indicated in this Box is the applicant's State (i.e. country) of residence if no State of residence is indicated below.)*

LEIJON, Mats

Hyvlargatan 5

S-723 35 VÄSTERÅS
Sweden

This person is:

☐ applicant only

☒ applicant and inventor

☐ inventor only *(If this check-box is marked, do not fill in below.)*

State *(i.e. country)* of nationality: SE

State *(i.e. country)* of residence: SE

This person is applicant for the purposes of: ☐ all designated States ☐ all designated States except the United States of America ☒ the United States of America only ☐ the States indicated in the Supplemental Box

☒ Further applicants and/or (further) inventors are indicated on a continuation sheet.

Box No. IV AGENT OR COMMON REPRESENTATIVE; OR ADDRESS FOR CORRESPONDENCE

The person identified below is hereby/has been appointed to act on behalf of the applicant(s) before the competent International Authorities as: ☒ agent ☐ common representative

Name and address: *(Family name followed by given name; for a legal entity, full official designation. The address must include postal code and name of country.)*

L.A.GROTH & Co.KB
KARLSSON, Leif et al.
Box 6107
S-102 32 STOCKHOLM
Sweden

Telephone No. +46 - 8 - 729 91 00

Facsimile No. +46 - 8 - 31 67 67

Teleprinter No.

☐ Mark this check-box where no agent or common representative is/has been appointed and the space above is used instead to indicate a special address to which correspondence should be sent.

Continuation of Box No. III FURTHER APPLICANTS AND/OR (FURTHER) INVENTORS

If none of the following sub-boxes is used, this sheet is not to be included in the request.

Name and address: *(Family name followed by given name; for a legal entity, full official designation. The address must include postal code and name of country. The country of the address indicated in this Box is the applicant's State (i.e. country) of residence if no State of residence is indicated below.)*

BERGGREN, Bertil
Rönnbergagatan 2 B

S-723 46 VÄSTERÅS
Sweden

This person is:
- [ ] applicant only
- [X] applicant and inventor
- [ ] inventor only *(If this check-box is marked, do not fill in below.)*

State *(i.e. country)* of nationality: SE

State *(i.e. country)* of residence: SE

This person is applicant for the purposes of: [ ] all designated States [ ] all designated States except the United States of America [X] the United States of America only [ ] the States indicated in the Supplemental Box

---

Name and address: *(Family name followed by given name; for a legal entity, full official designation. The address must include postal code and name of country. The country of the address indicated in this Box is the applicant's State (i.e. country) of residence if no State of residence is indicated below.)*

This person is:
- [ ] applicant only
- [ ] applicant and inventor
- [ ] inventor only *(If this check-box is marked, do not fill in below.)*

State *(i.e. country)* of nationality:

State *(i.e. country)* of residence:

This person is applicant for the purposes of: [ ] all designated States [ ] all designated States except the United States of America [ ] the United States of America only [ ] the States indicated in the Supplemental Box

---

Name and address: *(Family name followed by given name; for a legal entity, full official designation. The address must include postal code and name of country. The country of the address indicated in this Box is the applicant's State (i.e. country) of residence if no State of residence is indicated below.)*

This person is:
- [ ] applicant only
- [ ] applicant and inventor
- [ ] inventor only *(If this check-box is marked, do not fill in below.)*

State *(i.e. country)* of nationality:

State *(i.e. country)* of residence:

This person is applicant for the purposes of: [ ] all designated States [ ] all designated States except the United States of America [ ] the United States of America only [ ] the States indicated in the Supplemental Box

---

Name and address: *(Family name followed by given name; for a legal entity, full official designation. The address must include postal code and name of country. The country of the address indicated in this Box is the applicant's State (i.e. country) of residence if no State of residence is indicated below.)*

This person is:
- [ ] applicant only
- [ ] applicant and inventor
- [ ] inventor only *(If this check-box is marked, do not fill in below.)*

State *(i.e. country)* of nationality:

State *(i.e. country)* of residence:

This person is applicant for the purposes of: [ ] all designated States [ ] all designated States except the United States of America [ ] the United States of America only [ ] the States indicated in the Supplemental Box

---

[ ] Further applicants and/or (further) inventors are indicated on another continuation sheet.

See Notes to the request form

Box No.V DESIGNATION OF STATES

The following designations are hereby made under Rule 4.9(a) *(mark the applicable check-boxes; at least one must be marked)*:

Regional Patent

- ☒ AP ARIPO Patent: KE Kenya, LS Lesotho, MW Malawi, SD Sudan, SZ Swaziland, UG Uganda, and any other State which is a Contracting State of the Harare Protocol and of the PCT
- ☒ EA Eurasian Patent: AM Armenia, AZ Azerbaijan, BY Belarus, KG Kyrgyzstan, KZ Kazakstan, MD Republic of Moldova, RU Russian Federation, TJ Tajikistan, TM Turkmenistan, and any other State which is a Contracting State of the Eurasian Patent Convention and of the PCT
- ☒ EP European Patent: AT Austria, BE Belgium, CH and LI Switzerland and Liechtenstein, DE Germany, DK Denmark, ES Spain, FI Finland, FR France, GB United Kingdom, GR Greece, IE Ireland, IT Italy, LU Luxembourg, MC Monaco, NL Netherlands, PT Portugal, SE Sweden, and any other State which is a Contracting State of the European Patent Convention and of the PCT
- ☒ OA OAPI Patent: BF Burkina Faso, BJ Benin, CF Central African Republic, CG Congo, CI Côte d'Ivoire, CM Cameroon, GA Gabon, GN Guinea, ML Mali, MR Mauritania, NE Niger, SN Senegal, TD Chad, TG Togo, and any other State which is a member State of OAPI and a Contracting State of the PCT *(if other kind of protection or treatment desired, specify on dotted line)* .....

National Patent *(if other kind of protection or treatment desired, specify on dotted line)*:

- ☒ AL Albania
- ☒ AM Armenia
- ☒ AT Austria
- ☒ AU Australia
- ☒ AZ Azerbaijan
- ☒ BA Bosnia and Herzegovina
- ☒ BB Barbados
- ☒ BG Bulgaria
- ☒ BR Brazil
- ☒ BY Belarus
- ☒ CA Canada
- ☒ CH and LI Switzerland and Liechtenstein
- ☒ CN China
- ☒ CU Cuba
- ☒ CZ Czech Republic and utility model
- ☒ DE Germany and utility model
- ☒ DK Denmark and utility model
- ☒ EE Estonia
- ☒ ES Spain
- ☒ FI Finland and utility model
- ☒ GB United Kingdom
- ☒ GE Georgia
- ☒ HU Hungary
- ☒ IL Israel
- ☒ IS Iceland
- ☒ JP Japan
- ☒ KE Kenya
- ☒ KG Kyrgyzstan
- ☒ KP Democratic People's Republic of Korea
- ☒ KR Republic of Korea
- ☒ KZ Kazakstan
- ☒ LC Saint Lucia
- ☒ LK Sri Lanka
- ☒ LR Liberia
- ☒ LS Lesotho
- ☒ LT Lithuania
- ☒ LU Luxembourg
- ☒ LV Latvia
- ☒ MD Republic of Moldova
- ☒ MG Madagascar
- ☒ MK The former Yugoslav Republic of Macedonia
- ☒ MN Mongolia
- ☒ MW Malawi
- ☒ MX Mexico
- ☒ NO Norway
- ☒ NZ New Zealand
- ☒ PL Poland
- ☒ PT Portugal
- ☒ RO Romania
- ☒ RU Russian Federation
- ☒ SD Sudan
- ☒ SE Sweden
- ☒ SG Singapore
- ☒ SI Slovenia
- ☒ SK Slovakia
- ☒ TJ Tajikistan
- ☒ TM Turkmenistan
- ☒ TR Turkey
- ☒ TT Trinidad and Tobago
- ☒ UA Ukraine
- ☒ UG Uganda
- ☒ US United States of America
- ☒ UZ Uzbekistan
- ☒ VN Viet Nam

Check-boxes reserved for designating States (for the purposes of a national patent) which have become party to the PCT after issuance of this sheet:

- ☒ YU Jugoslavien (fr. 1997-02-01)
- ☒ GH Ghana (AP) (fr. 1997-02-26)
- ☐ .....
- ☐ .....

In addition to the designations made above, the applicant also makes under Rule 4.9(b) all designations which would be permitted under the PCT except the designation(s) of _____.

The applicant declares that those additional designations are subject to confirmation and that any designation which is not confirmed before the expiration of 15 months from the priority date is to be regarded as withdrawn by the applicant at the expiration of that time limit. *(Confirmation of a designation consists of the filing of a notice specifying that designation and the payment of the designation and confirmation fees. Confirmation must reach the receiving Office within the 15-month time limit.)*

See Notes to the request form

Box No. VI PRIORITY CLAIM Further priority claims are indicated in the Supplemental Box ☐

The priority of the following earlier application(s) is hereby claimed:

Country *(in which, or for which, the application was filed)*	Filing Date *(day/month/year)*	Application No.	Office of filing *(only for regional or international application)*
item (1) Sweden	29 May 1996 (29.05.1996)	9602079-7	
item (2)			
item (3)			

Mark the following check-box if the certified copy of the earlier application is to be issued by the Office which for the purposes of the present international application is the receiving Office (a fee may be required):

☒ The receiving Office is hereby requested to prepare and transmit to the International Bureau a certified copy of the earlier application(s) identified above as item(s) : (1)

Box No. VII INTERNATIONAL SEARCHING AUTHORITY

Choice of International Searching Authority (ISA) *(If two or more International Searching Authorities are competent to carry out the international search, indicate the Authority chosen; the two-letter code may be used):* ISA / SE

Earlier search *Fill in where a search (international, international-type or other) by the International Searching Authority has already been carried out or requested and the Authority is now requested to base the international search, to the extent possible, on the results of that earlier search. Identify such search or request either by reference to the relevant application (or the translation thereof) or by reference to the search request:*

Country (or regional Office):	Date *(day/month/year)*:	Number:
Sweden	29 May 1996	SE 96/00648

Box No. VIII CHECK LIST

This international application contains the following number of sheets:

1. request	: 4	sheets
2. description	: 13	sheets
3. claims	: 4	sheets
4. abstract	: 1	sheets
5. drawings	: 2	sheets
Total	: 24	sheets

This international application is accompanied by the item(s) marked below:

1. ☐ separate signed power of attorney
2. ☐ copy of general power of attorney
3. ☐ statement explaining lack of signature
4. ☐ priority document(s) *identified in Box No. VI as item(s):*
5. ☐ fee calculation sheet
6. ☐ separate indications concerning deposited microorganisms
7. ☐ nucleotide and/or amino acid sequence listing (diskette)
8. ☐ other *(specify)*:

Figure No. 2 of the drawings (if any) should accompany the abstract when it is published.

Box No. IX SIGNATURE OF APPLICANT OR AGENT

Next to each signature, indicate the name of the person signing and the capacity in which the person signs (if such capacity is not obvious from reading the request).

L.A.GROTH & Co.KB

Leif Karlsson

For receiving Office use only

1. Date of actual receipt of the purported international application:
3. Corrected date of actual receipt due to later but timely received papers or drawings completing the purported international application:
4. Date of timely receipt of the required corrections under PCT Article 11(2):
5. International Searching Authority specified by the applicant: ISA /
6. ☐ Transmittal of search copy delayed until search fee is paid

2. Drawings:
☐ received:
☐ not received:

For International Bureau use only

Date of receipt of the record copy by the International Bureau:

INTERNATIONAL SEARCH REPORT

Information on patent family members

30/06/98

International application No.
PCT/SE 97/00884

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 5036165 A	30/07/91	US 5066881 A	19/11/91
		US 5067046 A	19/11/91
		CA 1245270 A	22/11/88
		US 4853565 A	01/08/89
US 4368418 A	11/01/83	CA 1169125 A	12/06/84
		EP 0076848 A	20/04/83
		WO 8203734 A	28/10/82
SU 955369 A	30/08/82	NONE	
US 4429244 A	31/01/84	CA 1167898 A	22/05/84
		CH 663120 A,B	13/11/87
		DE 3050139 T	25/03/82
		FR 2473804 A,B	17/07/81
		GB 2081523 A,B	17/02/82
		JP 56501707 T	19/11/81
		SU 961048 A	23/09/82
		WO 8101775 A	25/06/81
SE 453236 B	18/01/88	AT 378287 A	10/07/85
		CH 657482 A,B	29/08/86
		DE 3200366 A	09/12/82
		FR 2499306 A,B	06/08/82
		SE 8200303 A	31/07/82
US 4091139 A	23/05/78	BE 846361 A	17/03/77
		CA 1071480 A	12/02/80
		CH 607251 A	30/11/78
		DE 2641406 A	31/03/77
		GB 1565696 A	23/04/80
		JP 1047401 C	28/05/81
		JP 52036783 A	22/03/77
		JP 55041483 B	24/10/80
US 4551780 A	05/11/85	AU 533597 B	01/12/83
		AU 5094879 A	17/07/80
		CA 1134901 A	02/11/82
		CH 651975 A,B	15/10/85
		DE 2903790 A	24/07/80
		FR 2446553 A,B	08/08/80
		SE 446289 B,C	25/08/86
		SE 8000104 A	11/07/80

REVISED VERSION

INTERNATIONAL SEARCH REPORT

International application No.
PCT/SE 97/00884

A. CLASSIFICATION OF SUBJECT MATTER

IPC6: H02K 3/40
According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC6: H02K

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

SE,DK,FI,NO classes as above

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	US 5036165 A (RICHARD K. ELTON ET AL.), 30 July 1991 (30.07.91), abstract, see the whole document	1-34,36-38
	--	
Y	US 4368418 A (F.P.DE MELLO ET AL), 11 January 1983 (11.01.83)	1-34,36-38
	--	
Y	SU 955369 A (GIDROPROEKT RES INST), 30 August 1982 (30.08.82), abstract	13
A		20
	--	

[X] Further documents are listed in the continuation of Box C. [X] See patent family annex.

* Special categories of cited documents:
"A" document defining the general state of the art which is not considered to be of particular relevance
"E" erlier document but published on or after the international filing date
"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)
"O" document referring to an oral disclosure, use, exhibition or other means
"P" document published prior to the international filing date but later than the priority date claimed
"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
"X" document of particular relevance: the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
"Y" document of particular relevance: the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
8 Sept 1997	16 -07- 1998
Name and mailing address of the ISA/ Swedish Patent Office Box 5055, S-102 42 STOCKHOLM	Authorized officer

INTERNATIONAL SEARCH REPORT

International application No.
PCT/SE 97/00884

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US 4429244 A (NIKITIN ET AL), 31 January 1984 (31.01.84), column 1, line 10 - line 58 --	1-34,36-38
A	SE 453236 B (ELIN-UNION AG FÜR ELECTRISCHE INDUSTRIE), 18 January 1988 (18.01.88) --	1-34,36-38
A	US 4091139 A (QUIRK), 23 May 1978 (23.05.78), abstract --	1-34,36-38
A	US 4551780 A (M.CANAY), 5 November 1985 (05.11.85), abstract --	16-17

INTERNATIONAL SEARCH REPORT

International application No.
PCT/SE 97/00884

Box I Observations where certain claims were found unsearchable (Continuation of item 1 of first sheet)

This international search report has not been established in respect of certain claims under Article 17(2)(a) for the following reasons:

1. ☐ Claims Nos.:
because they relate to subject matter not required to be searched by this Authority, namely:

2. ☒ Claims Nos.: 35
because they relate to parts of the international application that do not comply with the prescribed requirements to such an extent that no meaningful international search can be carried out, specifically:

See extra sheet.

3. ☐ Claims Nos.:
because they are dependent claims and are not drafted in accordance with the second and third sentences of Rule 6.4(a).

Box II Observations where unity of invention is lacking (Continuation of item 2 of first sheet)

This International Searching Authority found multiple inventions in this international application, as follows:

1. ☐ As all required additional search fees were timely paid by the applicant, this international search report covers all searchable claims.

2. ☐ As all searchable claims could be searched without effort justifying an additional fee, this Authority did not invite payment of any additional fee.

3. ☐ As only some of the required additional search fees were timely paid by the applicant, this international search report covers only those claims for which fees were paid, specifically claims Nos.:

4. ☐ No required additional search fees were timely paid by the applicant. Consequently, this international search report is restricted to the invention first mentioned in the claims; it is covered by claims Nos.:

Remark on Protest ☐ The additional search f

Claim 35 defines a synchronous compensator plant, having the capability to operate at voltages in excess of 36 kV. No special technical features are defined that provide this capability.

According to PCT/Guidelines/2/chapter 3.7 no special efforts need be made for searching unduly wide or speculative claims, beyond the extent to which they are supported by the description.

Since no further methods to achieve a synchronous compensator plant capable to operate at voltages in excess of 36 kV are disclosed in the description, other than those already defined in claims 1-34, no meaningful search can be carried out regarding claim 35.

Therefore this claims is considered unsearchable.

Chrystal 5620

38/973017

PCT/SE97/00884

PATENT COOPERATION TREATY

From the INTERNATIONAL BUREAU

PCT

NOTIFICATION OF ELECTION

(PCT Rule 61.2)

To:

United States Patent and Trademark Office
(Box PCT)
Crystal Plaza 2
Washington, DC 20231
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in its capacity as elected Office

Date of mailing (day/month/year) 20 January 1998 (20.01.98)	
International application No. PCT/SE97/00884	**Applicant's or agent's file reference** P 97-086/LK
International filing date (day/month/year) 27 May 1997 (27.05.97)	**Priority date** (day/month/year) 29 May 1996 (29.05.96)
Applicant LEIJON, Mats et al	

1. The designated Office is hereby notified of its election made:

   [X] in the demand filed with the International Preliminary Examining Authority on:

   19 December 1997 (19.12.97)

   [ ] in a notice effecting later election filed with the International Bureau on:

   _____

2. The election [X] was

   [ ] was not

   made before the expiration of 19 months from the priority date or, where Rule 32 applies, within the time limit under Rule 32.2(b).

The International Bureau of WIPO **34, chemin des Colombettes** **1211 Geneva 20, Switzerland** Facsimile No.: (41-22) 740.14.35	Authorized officer F. Gateau Telephone No.: (41-22) 338.83.38

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